



SEQUENCE LISTING

<110> Board of Trustees for University of Arkansas
<120> Mitogen-Activated Protein Kinase and Method of Use to Enhance Biotic and Abiotic Stress Tolerance in Plants
<130> UAF-03-14
<140> 60/444,249
<141> 2004-01-31
<160> 10
<170> PatentIn version 3.2
<210> 1
<211> 1396
<212> DNA
<213> Oryza sativa
<400> 1
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acggcggccg gtacctgctc tacgacatct tcggaaacaa gttcgaggtg acgaacaagt 180
accagccgcc catcatgccc attggccgcg ggcctacgg gatcgcttc tccgtatga 240
actttgagac gagggagatg gtggcgataa agaagatcgc caacgcgttc aacaacgaca 300
tggacgccaa gcgcacgctc cgggagatca agtcctcag gcacctcgac cacgagaaca 360
tcataggcat cagggatgtg atccgcgcgc cgatccctca ggcgttcaac gacgtctaca 420
tcgcccacgga gctcatggac accgacctcc atcacatcat ccgctccaac caagaactgt 480
cagaagagca ctgccagtat ttccctgtacc agatcctgcg gggctcaag tacatccact 540
cggcgaacgt gatccaccgc gacctgaagc cgagcaacct gctgctgaac gccaactgcg 600
acctcaagat ctgcgacttc gggctggcgc ggccgtcgtc ggagagcgcg atgatgacgg 660
agtacgttgtt caccgggtgg taccgcgcgc cggagctgct gctcaactcc accgactact 720
ccggcccat cgacgtctgg tccgtcggct gcatttcat ggagctcatc aaccggccagc 780
cgctttccc cggcaggagc cacatgcacc agatgcgcct catcaccgag gtgatcggga 840
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acctgcccga gtacccgcgc cggacgttcg cgagcatgtt cccgcgggtg cagccgcgg 960
cgctcgacct catcgagagg atgctcacct tcaacccgct gcagagaatc acagttgagg 1020

MAPK5.ST25

aggcgctcga tcatccttac ctagagagat tgcacgacat cgccgatgag cccatctgcc	1080
tggagccctt ctccttcgac ttgcggcaga aggctctaaa cgaggaccaa atgaagcagc	1140
tgatcttcaa cgaagcgatc gagatgaacc caaacatccg gtactagatt gaatcaccat	1200
ggaaatgaga tcccgcttat acctgctttg tacatatgat caagattgag agccggtag	1260
actgaacatt gcatttgttt gtttggat gttcgaaacc cacattctct gcaagttgtg	1320
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<210> 2
 <211> 368
 <212> PRT
 <213> Oryza sativa

 <400> 2

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Gly Arg Tyr Leu Leu Tyr Asp Ile Phe Gly Asn Lys Phe Glu Val Thr		
20	25	30

Asn Lys Tyr Gln Pro Pro Ile Met Pro Ile Gly Arg Gly Ala Tyr Gly		
35	40	45

Ile Val Cys Ser Val Met Asn Phe Glu Thr Arg Glu Met Val Ala Ile		
50	55	60

Lys Lys Ile Ala Asn Ala Phe Asn Asn Asp Met Asp Ala Lys Arg Thr			
65	70	75	80

Leu Arg Glu Ile Lys Leu Leu Arg His Leu Asp His Glu Asn Ile Ile		
85	90	95

Gly Ile Arg Asp Val Ile Pro Pro Ile Pro Gln Ala Phe Asn Asp		
100	105	110

Val Tyr Ile Ala Thr Glu Leu Met Asp Thr Asp Leu His His Ile Ile		
115	120	125

MAPK5.ST25

Arg Ser Asn Gln Glu Leu Ser Glu Glu His Cys Gln Tyr Phe Leu Tyr
130 135 140

Gln Ile Leu Arg Gly Leu Lys Tyr Ile His Ser Ala Asn Val Ile His
145 150 155 160

Arg Asp Leu Lys Pro Ser Asn Leu Leu Leu Asn Ala Asn Cys Asp Leu
165 170 175

Lys Ile Cys Asp Phe Gly Leu Ala Arg Pro Ser Ser Glu Ser Asp Met
180 185 190

Met Thr Glu Tyr Val Val Thr Arg Trp Tyr Arg Ala Pro Glu Leu Leu
195 200 205

Leu Asn Ser Thr Asp Tyr Ser Ala Ala Asp Val Trp Ser Val Gly Cys
210 215 220

Ile Phe Met Glu Leu Ile Asn Arg Gln Pro Leu Phe Pro Gly Arg Asp
225 230 235 240

His Met His Gln Met Arg Leu Ile Thr Glu Val Ile Gly Thr Pro Thr
245 250 255

Asp Asp Glu Leu Gly Phe Ile Arg Asn Glu Asp Ala Arg Lys Tyr Met
260 265 270

Arg His Leu Pro Gln Tyr Pro Arg Arg Thr Phe Ala Ser Met Phe Pro
275 280 285

Arg Val Gln Pro Ala Ala Leu Asp Leu Ile Glu Arg Met Leu Thr Phe
290 295 300

Asn Pro Leu Gln Arg Ile Thr Val Glu Glu Ala Leu Asp His Pro Tyr
305 310 315 320

Leu Glu Arg Leu His Asp Ile Ala Asp Glu Pro Ile Cys Leu Glu Pro
325 330 335

Phe Ser Phe Asp Phe Glu Gln Lys Ala Leu Asn Glu Asp Gln Met Lys
340 345 350

MAPK5, ST25

Gln Leu Ile Phe Asn Glu Ala Ile Glu Met Asn Pro Asn Ile Arg Tyr
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<210> 3
<211> 1084
<212> DNA
<213> *Oryza sativa*

<400> 3
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accagccgcc catcatgccc attggccgcg ggcctacgg gatcgctgc tccgtatga 240
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gcgacttcgg gctggcgccg ccgtcgctgg agagcgacat gatgacggag tacgtggta 360
cccggtggta ccgcgcgcgg gagctgctgc tcaactccac cgactactcc gccgcacatcg 420
acgtctggtc cgtcgctgc atcttcatgg agctcatcaa ccgcgcgcgg ctcttcccg 480
gcagggacca catgcaccagg atgcgcctca tcaccgaggt gatcgacggacg ccgacggacg 540
acgagctggg gttcatacgg aacgaggacg cgaggaagta catgaggcac ctgcgcagt 600
acccgcgcgg gacgttcgcg agcatgttcc cgcgggtgca gcccgcgcg ctcgacacctca 660
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ccgtctatac ctgctttgtt catatgatca agattgagag ccgggttagac tgaacattgc 960
atttgggttggat ttgttgcgt tcgaaacccca cattctctgc aagttgtggc tgctttgtat 1020
gatataatggt actatgttcg aataaaaggg tttggaaacctt tggattaaaa aaaaaaaaaaa 1080
aaaaa 1084

<210> 4
<211> 266
<212> PRT
<213> *Oryza sativa*

<400> 4

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Gly	Gly	Arg	Tyr	Leu	Leu	Tyr	Asp	Ile	Phe	Gly	Asn	Lys	Phe	Glu	Val
				20			25					30			

Thr	Asn	Lys	Tyr	Gln	Pro	Pro	Ile	Met	Pro	Ile	Gly	Arg	Gly	Ala	Tyr
					35		40				45				

Gly	Ile	Val	Cys	Ser	Val	Met	Asn	Phe	Glu	Thr	Arg	Glu	Met	Val	Ala
					50		55				60				

Ile	Lys	Lys	Ile	Ala	Asn	Cys	Asp	Leu	Lys	Ile	Cys	Asp	Phe	Gly	Leu
					65		70			75		80			

Ala	Arg	Pro	Ser	Ser	Glu	Ser	Asp	Met	Met	Thr	Glu	Tyr	Val	Val	Thr
					85			90			95				

Arg	Trp	Tyr	Arg	Ala	Pro	Glu	Leu	Leu	Leu	Asn	Ser	Thr	Asp	Tyr	Ser
					100		105				110				

Ala	Ala	Ile	Asp	Val	Trp	Ser	Val	Gly	Cys	Ile	Phe	Met	Glu	Leu	Ile
					115		120			125					

Asn	Arg	Gln	Pro	Leu	Phe	Pro	Gly	Arg	Asp	His	Met	His	Gln	Met	Arg
					130		135			140					

Leu	Ile	Thr	Glu	Val	Ile	Gly	Thr	Pro	Thr	Asp	Asp	Glu	Leu	Gly	Phe
					145		150			155		160			

Ile	Arg	Asn	Glu	Asp	Ala	Arg	Lys	Tyr	Met	Arg	His	Ile	Leu	Pro	Gln	Tyr
					165			170			175					

Pro	Arg	Arg	Thr	Phe	Ala	Ser	Met	Phe	Pro	Arg	Val	Gln	Pro	Ala	Ala
					180		185			190					

Leu	Asp	Leu	Ile	Glu	Arg	Met	Leu	Thr	Phe	Asn	Pro	Leu	Gln	Arg	Ile
					195		200				205				

Thr	Val	Glu	Glu	Ala	Leu	Asp	His	Pro	Tyr	Leu	Glu	Arg	Leu	His	Asp
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210

215

220

Ile Ala Asp Glu Pro Ile Cys Leu Glu Pro Phe Ser Phe Asp Phe Glu
 225 230 235 240

Gln Lys Ala Leu Asn Glu Asp Gln Met Lys Gln Leu Ile Phe Asn Glu
 245 250 255

Ala Ile Glu Met Asn Pro Asn Ile Arg Tyr
 260 265

<210> 5
 <211> 26
 <212> DNA
 <213> Artificial

<220>
 <223> gene-specific primer containing restriction site

<400> 5
 cggatccgt cggctgcatt ttcattg

26

<210> 6
 <211> 25
 <212> DNA
 <213> Artificial

<220>
 <223> gene-specific primer containing restriction site

<400> 6
 gctctagatt caatctagta ccgga

25

<210> 7
 <211> 20
 <212> DNA
 <213> Artificial

<220>
 <223> gene-specific primer containing restriction site

<400> 7
 gagttcaggc cgacgatgac

20

<210> 8
 <211> 20
 <212> DNA
 <213> Artificial

<220>

<223> gene-specific primer containing restriction site

<400> 8

atcggcgatg tcgtgcaatc

20

<210> 9

<211> 368

<212> PRT

<213> Triticum aestivum

<400> 9

Met	Asp	Gly	Ala	Pro	Val	Ala	Glu	Phe	Arg	Pro	Thr	Met	Thr	His	Gly
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Gly	Arg	Phe	Leu	Leu	Tyr	Asn	Ile	Phe	Gly	Asn	Gln	Phe	Glu	Thr	Thr
						20		25					30		

Ala	Lys	Tyr	Gln	Pro	Pro	Ile	Met	Pro	Ile	Gly	Lys	Gly	Ala	Tyr	Gly
						35		40			45				

Ile	Val	Cys	Ser	Val	Met	Asn	Phe	Glu	Thr	Arg	Glu	Met	Val	Ala	Ser
					50		55			60					

Lys	Lys	Ile	Ala	Asn	Ala	Phe	Asp	Asn	Asn	Met	Asp	Ala	Lys	Arg	Thr
						65		70		75			80		

Leu	Arg	Glu	Ile	Lys	Leu	Leu	Leu	Arg	His	Leu	Asp	Glu	Asn	Ile	Val
							85		90			95			

Gly	Leu	Arg	Asp	Val	Ile	Pro	Pro	Ala	Ile	Pro	Gln	Ser	Glu	Asn	Asp
					100				105			110			

Val	Tyr	Ile	Ala	Thr	Glu	Leu	Met	Asp	Thr	Asp	Leu	His	His	Ile	Ile
						115		120			125				

Arg	Ser	Asn	Gly	Glu	Leu	Ser	Glu	Glu	His	Glu	Gln	Tyr	Phe	Leu	Tyr
						130		135			140				

Gln	Leu	Leu	Arg	Gly	Leu	Lys	Tyr	Ile	His	Ser	Ala	Asn	Val	Ile	His
						145		150			155			160	

MAPK5.ST25

Arg Asp Leu Lys Pro Ser Asn Leu Leu Leu Asn Ala Asn Cys Asp Leu
165 170 175

Lys Ile Cys Asp Phe Gly Leu Ala Arg Pro Ser Ser Glu Ser Asp Met
180 185 190

Met Thr Glu Tyr Val Val Thr Arg Trp Tyr Arg Ala Pro Glu Leu Leu
195 200 205

Leu Asn Ser Thr Asp Tyr Ser Ala Asn Ile Asp Val Trp Ser Val Gly
210 215 220

Cys Ile Phe Met Glu Leu Ile Asn Arg Ala Pro Leu Phe Pro Gly Arg
225 230 235 240

Asp His Met His Gln Met Arg Leu Ile Thr Glu Val Ile Gly Thr Pro
245 250 255

Thr Asp Asp Asp Leu Gly Phe Ile Arg Asn Glu Asp Ala Arg Arg Tyr
260 265 270

Met Arg His Leu Pro Gln Phe Pro Arg Arg Ser Phe Pro Gly Phe Pro
275 280 285

Lys Val Gln Pro Ala Ala Leu Asp Leu Ile Glu Arg Met Leu Thr Phe
290 295 300

Asn Pro Leu Gln Arg Ile Thr Val Glu Glu Ala Leu Glu His Pro Tyr
305 310 315 320

Leu Glu Arg Leu His Asp Val Ala Asp Glu Pro Ile Cys Thr Asp Pro
325 330 335

Phe Ser Phe Asp Phe Glu Gln His Pro Leu Thr Glu Asp Gln Met Lys
340 345 350

Leu Ile Pro Glu Asn Glu Ala Leu Glu Leu Asn Pro Asn Phe Arg Tyr
355 360 365

<210> 10
<211> 371
<212> PRT

<213> Nicotiana tabacum

<400> 10

Met Ala Asp Ala Asn Met Gly Ala Gly Gly Gln Phe Pro Asp Phe
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Pro Ser Val Leu Thr His Gly Gly Gln Tyr Val Gln Phe Asp Asp Ile
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Phe Gly Asn Phe Phe Glu Ile Thr Thr Lys Tyr Arg Pro Pro Ile Met
35 40 45

Pro Ile Gly Arg Gly Ala Tyr Ile Val Cys Ser Val Leu Asn Thr Glu
50 55 60

Leu Asn Glu Met Val Ala Val Lys Lys Ile Ala Asn Ala Phe Asn Tyr
65 70 75 80

Met Asp Ala Lys Arg Thr Leu Arg Glu Ile Lys Leu Leu Arg His Leu
85 90 95

Asp His Glu Asn Val Ile Gly Leu Arg Asp Val Ile Pro Pro Pro Leu
100 105 110

Arg Arg Glu Phe Ser Asp Val Tyr Ile Ala Thr Glu Leu Met Asp Thr
115 120 125

Asp Leu His Gln Ile Ile Arg Ser Asn Gln Gly Leu Ser Glu Asp His
130 135 140

Cys Gln Tyr Phe Met Tyr Gln Leu Leu Arg Gly Leu Lys Tyr Ile His
145 150 155 160

Ser Ala Asn Val Leu His Arg Asp Leu Lys Pro Ser Asn Leu Leu Val
165 170 175

Asn Ala Asn Cys Asp Leu Lys Ile Cys Asp Phe Gly Leu Ala Arg Pro
180 185 190

Asn Ile Glu Asn Glu Asn Met Thr Glu Tyr Val Val Thr Arg Trp Tyr
195 200 205

MAPK5.ST25

Arg Ala Pro Glu Leu Leu Asn Ser Thr Asp Tyr Ser Ala Ala Ile Asp
210 215 220

Val Trp Ser Val Gly Cys Ile Phe Met Glu Leu Ile Asn Arg Lys Pro
225 230 235 240

Leu Phe Pro Gly Lys Asp His Ile His Gln Met Arg Leu Ile Thr Glu
245 250 255

Val Ile Gly Thr Pro Thr Glu Ala Asp Leu Gly Phe Leu Gln Asn Glu
260 265 270

Asp Ala Arg Arg Tyr Ile Arg Gln Leu Pro Gln His Pro Arg Gln Gln
275 280 285

Leu Ala Glu Val Phe Pro His Val Asn Pro Leu Ala Ile Asp Leu Val
290 295 300

Asp Lys Met Leu Thr Phe Asp Pro Thr Arg Arg Ile Glu Glu Ala Leu
305 310 315 320

Asp His Pro Tyr Leu Ala Lys Leu His Asp Ala Gly Asp Glu Pro Ile
325 330 335

Cys Pro Val Pro Phe Ser Phe Asp Phe Glu Gln Gln Gly Ile Gly Glu
340 345 350

Glu Gln Ile Lys Asp Met Ile Tyr Gln Glu Ala Leu Ser Leu Asn Pro
355 360 365

Glu Tyr Ala
370